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UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))	Attorney Docket No.	P4505
	First Inventor or Application Identifier	David Skirmont et al.
	Title	Router-Level Automatic Protection Switching
	Express Mail Label No.	EL573444318US

APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) (Submit an original and a duplicate for fee processing) 2. <input checked="" type="checkbox"/> Specification [Total Pages 15] (preferred arrangement set forth below) - Descriptive title of the Invention - Cross References to Related Applications - Statement Regarding Fed sponsored R & D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure 3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets 6] 4. Oath or Declaration [Total Pages 2] a. <input checked="" type="checkbox"/> Newly executed (original or copy) b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) (for continuation/divisional with Box 16 completed) i. <input type="checkbox"/> <u>DELETION OF INVENTOR(S)</u> Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).	5. <input type="checkbox"/> Microfiche Computer Program (Appendix) 6. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary) a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies
ACCOMPANYING APPLICATION PARTS 7. <input type="checkbox"/> Assignment Papers (cover sheet & document(s)) 8. <input type="checkbox"/> 37 C.F.R. § 3.73(b) Statement (when there is an assignee) <input checked="" type="checkbox"/> Power of Attorney 9. <input type="checkbox"/> English Translation Document (if applicable) 10. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations 11. <input type="checkbox"/> Preliminary Amendment 12. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) (Should be specifically itemized) 13. <input checked="" type="checkbox"/> * Small Entity Statement(s) <input type="checkbox"/> Statement filed in prior application, Status still proper and desired (PTO/SB/09-12) 14. <input type="checkbox"/> Certified Copy of Priority Document(s) (if foreign priority is claimed) 15. <input checked="" type="checkbox"/> Other: Check for fees	

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: _____
Prior application information: Examiner _____ Group / Art Unit: _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

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Name (Print/Type)	Donald R. Bays	Registration No. (Attorney/Agent)	35074
Signature	<i>Donald R. Bays</i>	Date	09/15/2000

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<h2 style="margin: 0;">FEE TRANSMITTAL</h2> <p style="font-size: small; margin: 5px 0;">Note: Effective October 1, 1997. Patent fees are subject to annual revision.</p>	<p style="text-align: center; margin: 0;">Complete if Known</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 60%;">Application Number</td><td>NA</td></tr> <tr><td>Filing Date</td><td>09/15/2000</td></tr> <tr><td>First Named Inventor</td><td>David Skirmont et al.</td></tr> <tr><td>Group Art Unit</td><td>NA</td></tr> <tr><td>Examiner Name</td><td>NA</td></tr> <tr><td>Attorney Docket Number</td><td>P4505</td></tr> </table>	Application Number	NA	Filing Date	09/15/2000	First Named Inventor	David Skirmont et al.	Group Art Unit	NA	Examiner Name	NA	Attorney Docket Number	P4505
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METHOD OF PAYMENT (check one)	FEE CALCULATION (continued)																																																																																																																																																																																				
<p>1. <input type="checkbox"/> The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:</p> <p>Deposit Account Number </p> <p>Deposit Account Name </p> <p><input type="checkbox"/> Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17 <input type="checkbox"/> Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance</p> <p>2. <input checked="" type="checkbox"/> Payment Enclosed: <input checked="" type="checkbox"/> Check <input type="checkbox"/> Money Order <input type="checkbox"/> Other</p>	<p>3. ADDITIONAL FEES</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Large Fee Code</th> <th>Entity (\$)</th> <th>Small Fee Code</th> <th>Entity (\$)</th> <th>Fee Description</th> <th>Fee Paid</th> </tr> </thead> <tbody> <tr><td>105</td><td>130</td><td>205</td><td>65</td><td>Surcharge - late filing fee or oath</td><td></td></tr> <tr><td>127</td><td>50</td><td>227</td><td>25</td><td>Surcharge - late provisional filing fee or cover sheet.</td><td></td></tr> <tr><td>139</td><td>130</td><td>139</td><td>130</td><td>Non-English specification</td><td></td></tr> <tr><td>147</td><td>2,520</td><td>147</td><td>2,520</td><td>For filing a request for reexamination</td><td></td></tr> <tr><td>112</td><td>920*</td><td>112</td><td>920*</td><td>Requesting publication of SIR prior to Examiner action</td><td></td></tr> <tr><td>113</td><td>1,840*</td><td>113</td><td>1,840*</td><td>Requesting publication of SIR after Examiner action</td><td></td></tr> <tr><td>115</td><td>110</td><td>215</td><td>55</td><td>Extension for reply within first month</td><td></td></tr> <tr><td>116</td><td>400</td><td>216</td><td>200</td><td>Extension for reply within second month</td><td></td></tr> <tr><td>117</td><td>950</td><td>217</td><td>475</td><td>Extension for reply within third month</td><td></td></tr> <tr><td>118</td><td>1,510</td><td>218</td><td>755</td><td>Extension for reply within fourth month</td><td></td></tr> <tr><td>128</td><td>2,060</td><td>228</td><td>1,030</td><td>Extension for reply within fifth month</td><td></td></tr> <tr><td>119</td><td>310</td><td>219</td><td>155</td><td>Notice of Appeal</td><td></td></tr> <tr><td>120</td><td>310</td><td>220</td><td>155</td><td>Filing a brief in support of an appeal</td><td></td></tr> <tr><td>121</td><td>270</td><td>221</td><td>135</td><td>Request for oral hearing</td><td></td></tr> <tr><td>138</td><td>1,510</td><td>138</td><td>1,510</td><td>Petition to institute a public use proceeding</td><td></td></tr> <tr><td>140</td><td>110</td><td>240</td><td>55</td><td>Petition to revive - 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SUBMITTED BY				Complete (if applicable)	
Typed or Printed Name	Donald R. Boys			Reg. Number	35,074
Signature		Date	09/15/2000	Deposit Account User ID	

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Certificate of Express Mailing

"Express Mail" Mailing Label Number: **EL573444318US**

Date of Deposit: **09/15/2000**

Ref: Case Docket No.: **P4505**

First Named Inventor: **David Skirmont et al.**

Serial Number: **NA**

Filing Date: **09/15/2000**

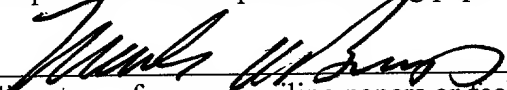
Title of Case: **Router-Level Automatic Protection Switching**

I hereby certify that the attached papers are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and addressed to the Commissioner of Patents and Trademarks, Washington D.C. 20231

1. Utility patent application transmittal.
2. 15 sheets of specification.
3. 6 sheets of drawings.
4. Fee transmittal.
5. Duplicate fee transmittal.
6. Declaration and Power of Attorney.
7. Verified Statement Claiming Small Entity.
8. Check for fees in the amount of \$345.00.
9. Certificate of express mailing.
10. Postcard listing contents.

Mark A. Boys

(Typed or printed name of person mailing paper or fee)


(Signature of person mailing papers or fee)

**VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN**

Docket Number (Optional)
P4505

Applicant or Patentee: David Skirmont et al.
Application or Patent No.: NA
Filed or Issued: NA
Title: Roter-Level Automatic Protection Switching

I hereby declare that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN Pluris, Inc.

ADDRESS OF SMALL BUSINESS CONCERN 10455 Bandlely Drive, Cupertino, CA 95014

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time, or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate verified statements averring to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

- Each person, concern, or organization having any rights in the invention is listed below:
☒ no such person, concern, or organization exists.
☐ each such person, concern, or organization is listed below.

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

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SIGNATURE _____ DATE _____

Router-Level Automatic Protection Switching

by inventor(s)

David Skirmont and Puneet Agarwal

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Field of the Invention

10 The present invention is in the area of data packet routers for use with wide-area networks, such as the Internet, and pertains more particularly to Automatic Protection Switching (APS) within such routers.

Background of the Invention

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At the time of the present patent application demand for increased data capacity and efficiency in Internet traffic continues to increase dramatically as more individuals and businesses increase their use of the Internet. The ever-increasing demand also drives development of equipment for the Internet such as data packet routers. A number of enterprises are developing routers that are capable of faster and higher capacity handling of data packets.

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The Internet, operating globally, comprises components from a wide variety of companies and organizations. It is, of course, necessary that such equipment conform to certain hardware and connection standards and operate by certain data transfer standards and protocols. These standards are all well known to the skilled artisan.

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As new and better equipment for routing data traffic in the Internet continues to be developed, researchers developing such equipment are including fault tolerance, diagnostic capabilities, and redundancy into the

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equipment, links between instances of routing equipment, and in routing protocols. At the time of the present patent application, for example, there exist redundancy systems for data traffic between routers, generally termed Automatic Protection Switching (APS) in the art. APS is described in more
5 detail as it exists in the art below, under the section entitled "Description of the Preferred Embodiments".

One of the important developments in Internet technology as of the time of filing of the present patent application is in development of faster, and scalable routers. The present inventors, for example, are involved in
10 development of what are known in the art as Terabit routers, capable of much higher packet transfer rates than currently available in the art.

It is highly desirable in new and faster routers to make very quick switchover to alternate routing paths if there should be a failure, impeding flow of data packets. The need for quick reaction is quite simply the fact
15 that many packets (much data) is lost with slower switchover. It is therefore desirable to have a quick hardware temporary solution in the event of component failure, followed by a more complete software solution, and then eventual repair. It is to this need for quick reaction to partial failure in routers, that is, failure of individual paths and components, to which the
20 present application is addressed. The inventors have developed apparatus and methods for addressing this need.

Summary of the Invention

25 In a preferred embodiment of the present invention a method is provided for redirecting packets received in a line card in a data packet router, the packets received by fabric interface circuitry on the line card and destined for a port on the line card. A preferred embodiment comprises the

steps of monitoring port status by a CPU on the line card, updating of information in the fabric interface circuitry by the CPU listing port status as active or failed and an alternative destination for each port, checking the table by the interface circuitry for a packet received, and sending the received packet to the predestined port if the port is listed in the table as active, and sending the received packet to the alternative destination if the port is listed in the table as failed. In another embodiment a method is provided wherein the fabric interface circuitry comprises one or more Global Fabric application-specific integrated circuits (GFRs).

In another embodiment a method is provided wherein the line card comprises four external ports and two GFRs. In another embodiment a method is provided wherein the operations of the interface circuitry in the steps of checking the table by the interface circuitry for a packet received, and sending the received packet to the predestined port if the port is listed in the table as active, and sending the received packet to the alternative destination if the port is listed in the table as failed, are implemented in hardware logic. In another embodiment a method is provided wherein, during the step of sending the received packet to the predestined port if the port is listed in the table as active, and sending the received packet to the alternative destination if the port is listed in the table as failed, a fabric interface circuit on an alternate line card is the alternative destination. In another embodiment a method for redirecting packets is provided wherein pre-destinations and alternative destinations are noted by destination tags associated with packets in process.

In another aspect of the invention a router line card is provided, the card enabled for Automatic Protection Switching and comprising multiple external port circuits connecting to external transmission links, a CPU, one or more fabric interface circuits connecting to router fabric cards, and

interconnect circuitry on the line card interconnecting the port circuits, the CPU and the fabric interface circuits. The card is characterized in that the CPU monitors the ports and updates information in the fabric interface circuits for ports active or failed, and the fabric interface circuits check predestination for each packet received from the fabric, and redirect all packets predestined for failed ports. In another embodiment a router line card is provided having a fabric interface circuitry comprising of one or more Global Fabric application-specific integrated circuits (GFRs).

In some other embodiments a router line card comprises of four external ports and two GFRs, or has steps wherein the operations of the interface circuitry are implemented in hardware logic. In other embodiments a router line card has a fabric interface circuit on an alternate line card as an alternative destination for a redirected packet, and has predestinations and alternative destinations noted by destination tags associated with packets in process.

In another preferred embodiment a data packet router is provided having line cards internally connected by fabric circuitry, wherein individual ones of the line cards comprise multiple external port circuits connecting to external transmission links, a CPU, one or more fabric interface circuits connecting to router fabric cards, and circuitry interconnecting the port circuits, the CPU and the fabric interface circuits. In a preferred embodiment the method is characterized in that the CPU on individual ones of the line cards monitor the ports and update information in the fabric interface circuits for ports active or failed, and the fabric interface circuits check predestination for each packet received from the fabric, and redirect all packets predestined for failed ports. In another embodiment a data packet router can have fabric interface circuitry comprising one or more Global Fabric application-specific integrated circuits (GFRs). In

some other embodiments a data packet router comprises four external ports and two GFRs, and logic in the GFRs may be implemented in hardware. In other embodiments a data packet router has a fabric interface circuit on an alternate line card as an alternative destination for a redirected packet, and
5 has pre-destinations and alternative destinations noted by destination tags associated with packets in process.

In all the preferred embodiments of the invention improved method and apparatus is provided allowing new and faster data packet processing hardware to make very quick switchover to alternate routing paths,
10 providing an improved solution to lost data caused by slower switching during a component failure.

Brief Description of the Drawing Figures

15 Fig. 1 is a block diagram of a prior art situation, illustrating redundant switching between two routers in the Internet network.

Fig. 2 is a block diagram also labeled prior art showing two edge routers in the Internet connected to a ring of ADM machines.

20 Fig. 3 is a block diagram also labeled prior art illustrating additional detail of ADM architecture.

Fig. 4 is a block diagram illustrating a router configuration according to an embodiment of the present invention.

25 Fig. 5 is a block diagram illustrating more detail of a router configuration and second line card according to an embodiment of the present invention.

Fig. 6 is a table showing ports and associated line items for the first line card of Fig. 5.

Description of the Preferred Embodiments

Fig. 1 is a block diagram of a prior art situation, illustrating redundant switching between two routers in the Internet network. Fig. 1 is intended to describe the very general problems that might occur in the Internet between two routers 11 and 13, wherein there is a primary link 15, labeled primary, between an interface 1 (17) on router 1 and an interface 1 (19) on router 2. This primary connection transfers data in both directions, as is indicated by the two-way arrows. In the event there is an equipment failure, software failure, routing path failure, or some other sort of failure, that effects the ability of the primary link to transfer data, there needs to be some form of redundancy. Such a failure can be complete, such as a break in an optic cable, or partial, such as a failure of one or more ports on a line card serving a link.

When a failure or partial failure occurs, such as described immediately above, there needs to be a method and protocol for switching the traffic from the primary link to a secondary, or redundant link, such as link 21 shown in Fig. 1, between two different interfaces labeled INT 2 on each of routers 11 and 13, and labeled also as elements 23 and 25. This switchover needs to happen very quickly, because all packets in process at either router for transfer by the primary link (15) will typically be lost (dropped) until the switchover takes place.

There is in the current art a fiber optic standard known as the SONET standard, which defines considerable standard and protocol for error correction, failure switching, and so forth, for taking care of just these kinds of failures, and for quickly compensating for such failures. These protocols operate on what are known as SONET boxes in the art, which are

routing boxes built to, and operating by SONET standards. These boxes do not encompass all Internet routers.

Fig. 2 is a prior art diagram showing a ring 27 of Add-Drop Multiplexers (ADM) with two routers 31 and 33 connected to the ring. This diagram illustrates the general and typical connection schematic for router interconnection in the Internet, wherein edge routers are connected to individual users, for example, and ADM boxes are used for more core transmission applications. The ADM boxes are SONET devices.

Fig. 3 is a block diagram illustrating additional detail of architecture of a SONET box 35, such as an ADM, in particular on what is known as the line side; that is the side interfacing to transmission lines or links. A Framers 39 on a line card 37 interfaces through both input and output paths to a number of port cards (PC) 41. Data out from the framer through port cards goes to remote destinations, and data coming in from remote destinations through other port cards is transferred via a multiplexer 43 to framer 39. APS is implemented in the art by switching data from primary port cards to redundant port cards.

Fig. 4, also labeled prior art, is a block diagram illustrating a router 44, such as a terabit scalable router that may be used as an edge router, such as routers 31 and 33 in Fig. 2. There are 5 line cards 45, 47, 49, 51 and 53 shown for router 44 in Fig. 4, interconnected in the router by switching fabric 55. Each of line cards 45-53 typically has on-card ports, which may be, for example, OC-48c ports known as Packet Processing ASICs (PPAs). The fact that there are no port cards in these routers that are not SONET boxes is an important reason why it is difficult to provide truly rapid protection switching.

In a preferred embodiment of the present invention the inventors have provided automatic protection switching at the level of ports (PPAs)

on line cards within an individual router. Fig. 5 is a block diagram illustrating more detail of a single line card of router 44 of Fig. 4, and a second line card 47. In this example, any two of the line cards of the router of Fig. 4 will serve. The switching fabric is element 55. Line card 45 has a CPU 57, interconnect structure 59, and four active ports 60-63 labeled Pt 0 through Pt 3. Each port represents a PPA. The standby port could be on the same line card as the active ports or ports it protects.

The fabric interface for the active line card is an application-specific integrated circuit (ASIC) termed a Global Fabric ASIC and referred to by the inventors by the acronym GFR. In a particular embodiment there are four PPAs on the line card, as shown, each capable of data transfer at 2.5 Gb/s, so the line card is capable of overall data transfer of 10 Gb/s. Each line card in this example has two GFR ASICs, labeled in Fig. 5 as GFRs 65 and 67, for redundancy and performance.

In operation, each GFR on an active line card connects to a fabric card in the fabric structure 55. Data packets being sent into the fabric from a line card are tagged in operations of elements on the line card, in this case typically with a four digit decimal number (which may, of course be rendered in HEX or binary for computing purposes), designating the router destination, and data packets received from the fabric at a GFR come with tags for the GFR receiving them.

In a preferred embodiment of the present invention CPU 57 on active line card 45, following a code sequence, monitors the PPAs, such as PPAs 60-63 on the line card for performance to a standard. This monitoring may be on a continuous or a semi-continuous basis (periodic). Also in this embodiment each GFR stores a port-status table, shown in simplified form in Fig. 6, with a line item for at least each port on the active card. In embodiments of the invention such a table may be stored elsewhere than on

a GFR, such as on a PPA, on a fabric card, or elsewhere, as long as access may be made to the port-status table.

Three columns are shown in the table of Fig. 6, a first column indicating each port on the card, a second column with an entry for whether the port is active (meets performance standard) or faulty, and a third column with a redirect tag number. The status column may be a single bit, for example, with a 1 indicating active and a 0 indicating fault (or vice versa), and the redirect tag is a destination tag for a standby port for each port. In some cases the redirect will be the same for all line entries, and in other cases the redirect may be different for each line entry.

On a packet-by-packet basis, as each packet comes into the active line card from the fabric, the receiving GFR checks the table for fault status. If the port is active, the packet goes on to the port. If the status is fault, the GFR replaces the existing tag with the redirect tag, and the packet is bounced back into the fabric and on to the line card 47 which in this case has the standby port.

In operation before the advent of this invention, status could be monitored, and forwarding tables updated on a regular basis, but the process was much too slow to avoid loss of significant quantities of packets. With the redirect tables in the GFRs and PPAs and redirecting packets immediately as the CPU notices faults, packets that would otherwise be lost are redirected and therefore saved. If it is desired to replace the line card with the failed port, the forwarding tables may be updated to direct all traffic away from that line card. Then the line card may be conveniently replaced.

In an alternative embodiment of the present invention the techniques described above related to GFRs on line cards can also be applied within an interconnection network, or fabric, connecting multiple line cards or

interfaces. For example, by updating a port redirect table in each fabric element which connects to a line card, those fabric elements can redirect all traffic destined for ports on that line card.

It will be apparent to the skilled artisan that there are many
5 alterations that might be made in embodiments of the inventions described herein within the spirit and scope of the invention. For example, there are different ways the necessary code may be generated, and different ways the invention may be managed in different line cards in different routers. There are many other possible alterations, and the invention should accordingly
10 be granted the scope of the claims that follow.

005120-2323330

What is claimed is:

1. In a data packet router, a method for redirecting packets destined for a port, comprising the steps of:

- 5 (a) monitoring port status on a continuing or periodic basis;
- (b) updating a port-status table, listing port status as active or failed and an alternative destination for each port;
- (c) checking the table by circuitry along a packet route for a packet en route; and
- 10 (d) sending the received packet to the predestined port if the port is listed in the table as active, and sending the received packet to the alternative destination if the port is listed in the table as failed.

15 2. The method of claim 1 wherein the port-status table is stored in a fabric interface circuitry and checking and redirecting is implemented in the fabric circuitry.

20 3. The method of claim 1 wherein the port-status table is stored in one of a Global Fabric ASIC on a line card or a Packet Processing ASIC (PPA) on a line card, and redirection is enabled by a CPU on the line card.

 4. The method of claim 1 wherein the operations of the interface circuitry in steps (c) and (d) are implemented in hardware logic.

25 5. The method of claim 1 wherein, in step (d) the alternative destination is a PPA on an alternate line card.

6. The method of claim 1 wherein pre-destinations and alternative destinations are noted by destination tags associated with packets in process.

5 7. A router card enabled for Automatic Protection Switching (APS), and comprising:

one or more circuits enabled for forwarding data packets; and
a port-status table;

10 characterized in that the port-status table lists individual port's status as active or failed, and also alternative destinations for the ports, and in that packets predestined for failed ports are redirected to alternative ports.

15 8. The card of claim 7 wherein the card is a line card comprising one or more Global Fabric application-specific integrated circuits (GFRs) as interface circuits to interconnecting fabric.

9. The card of claim 7 wherein the card is a fabric card interconnecting line cards.

20 10. The card of claim 7 wherein the operations of the one or more circuits for forwarding are implemented in hardware logic.

11. The card of claim 7 wherein the alternative destination for a redirected packet is a port on a line card.

25

12. The card of claim 7 wherein pre-destinations and alternative destinations are noted by destination tags associated with packets in process.

13. A data packet router having externally-facing line cards internally connected by fabric cards, wherein individual ones of the cards comprise:

one or more circuits enabled for forwarding data packets; and

5 a port-status table;

characterized in that the port-status table lists individual port's status as active or failed, and also alternative destinations for the ports, and in that packets predestined for failed ports are redirected to alternative ports.

10 14. The router of claim 13 wherein the line card comprises one or more Global Fabric application-specific integrated circuits (GFRs) as interface circuits to interconnecting fabric.

15 15. The router of claim 13 wherein the operations of the one or more circuits for forwarding are implemented in hardware logic.

16. The router of claim 13 wherein the alternative destination for a redirected packet is a port on a line card.

20 17. The router of claim 13 wherein pre-destinations and alternative destinations are noted by destination tags associated with packets in process.

25 18. The method of claim 1 wherein the port status table is a distributed table with portions stored in separate places.

19. The method of claim 1 wherein the alternative destination is on the same line card receiving and redirecting the packets.

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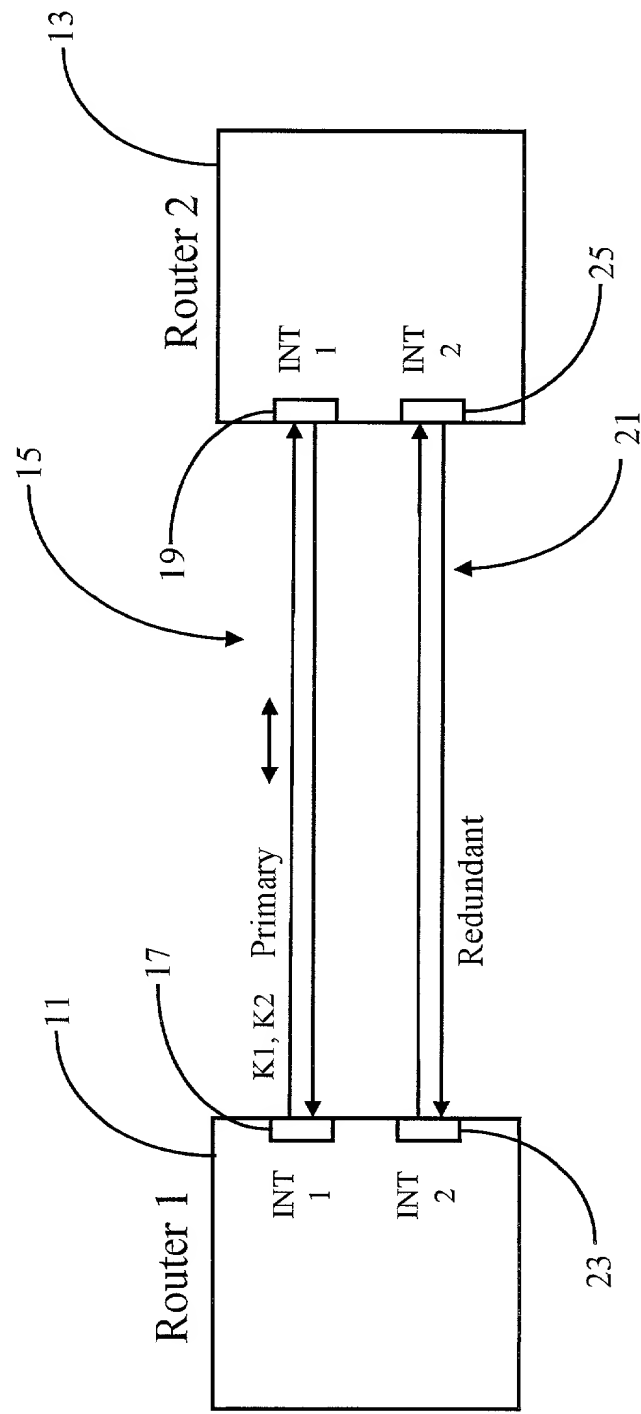


Fig. 1 (Prior Art)

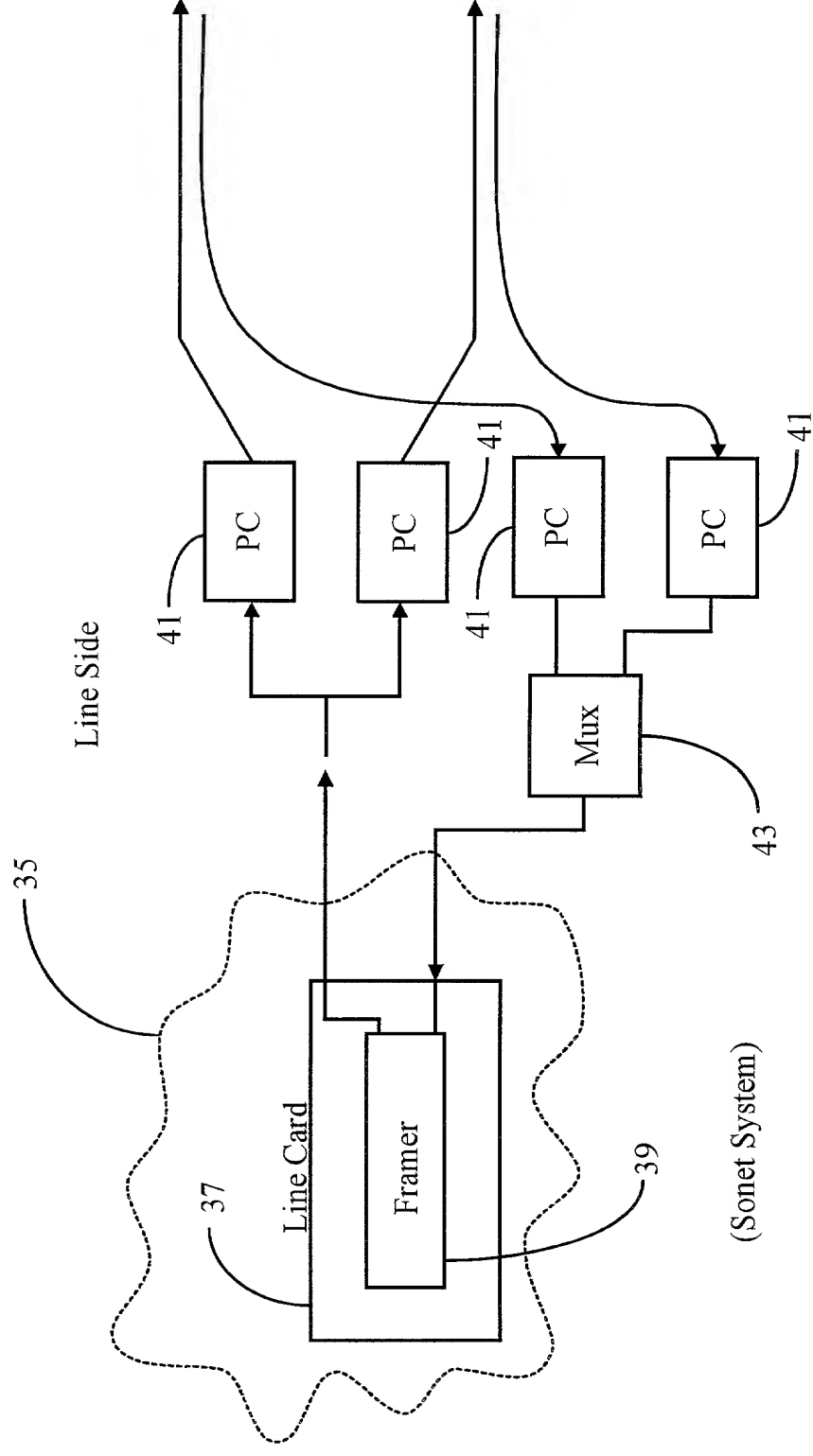


Fig. 3 (Prior Art)

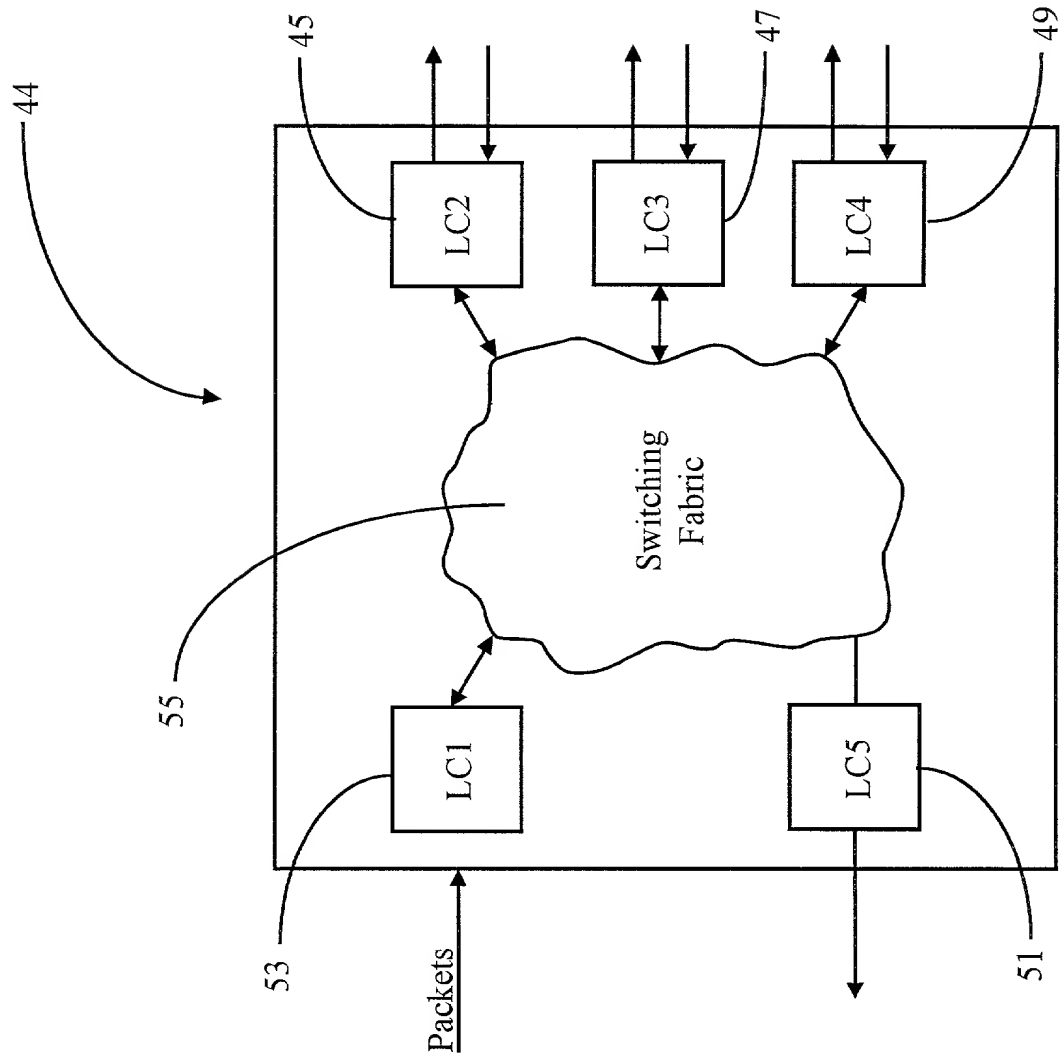


Fig. 4 (Prior Art)

005F60-898E99B0

<u>Port</u>	<u>Status</u>	<u>Redirect</u>
0	active	9327
1	failed	9327
2	failed	4674
3	active	9218
.		
.		
n		

Fig. 6

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

ATTORNEY DOCKET NO. **P4505**

As a below named inventor, I hereby declare that: My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **Router-Level Automatic Protection Switching**

the specification of which (check one) ☒ is attached hereto.
☐ was filed on:
☐ Application Serial No.
☐ and was amended on
(If applicable)

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, s 1.56 (a). In the case that the present application is a continuation-in-part application, I further acknowledge the duty to disclose material information as defined in 37 CFR s 1.56(a) which became available between the filing date of the prior application and the filing date of the present application. I hereby claim foreign priority benefits under Title 35, United States Code s119 of any foreign applications for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)	(Number)	(Country)	(Day/Month/Year Filed)
	(Number)	(Country)	(Day/Month/Year Filed)

I hereby claim the benefit under Title 35, United States Code, s120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, s112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, s156(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.): _____	(Filing Date): _____	(Status): _____
(Application Serial No.): _____	(Filing Date): _____	(Status): _____
(Application Serial No.): _____	(Filing Date): _____	(Status): _____
(Application Serial No.): _____	(Filing Date): _____	(Status): _____
(Application Serial No.): _____	(Filing Date): _____	(Status): _____

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.
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